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Emergency response: Elearning for paramedics and firefighters

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This article is based on an innovative research project with academics, software developers, and organizational pilot sites to design and develop elearning software for an emergency response simulation with supporting collaborative tools. In particular, this article focuses on the research that the author has conducted to provide the theoretical foundations for the project. After discussing the unique characteristics of the SIMergency project, the author provides a critical applied analysis of learning principles directly related to simulation and gaming; stresses the importance of balancing virtual methods with face-to-face interaction; and examines design principles that place learning before technology in an emergency response organizational context. This research, although concentrating on paramedics and firefighters, is transferable to other organizations, and it highlights the importance of collaborative learning. It also emphasizes the crucial use of simulations based on real life for preparing people to deal with stressful and challenging situations in their work.

KEYWORDS: *collaborative learning; experiential learning; elearning; emergency response; firefighting; learning communities; learning theory; organizational learning; paramedics; simulations; software development; technology*

Today's market is awash in new elearning and simulation software. There have been incredible advances in these areas, but perhaps one of the most important involves the integration of theoretical and practical learning principles with collaborative solutions. The SIMergency Project: Collaborative Learning Within an Emergency Response Simulation, spearheaded by Mount Saint Vincent University and partially funded by the Atlantic Canada Opportunities Agency, aims to contribute to the elearning field by exploring how learning theory can drive collaborative, engaging simulations for organizational learning. As a project team consisting of academics, software developers, and organizational resource personnel, we are engaging with theoretical research; organizational case studies; and software development, implementation, and evaluation. In particular, we are working with partner pilot sites involved in emergency response (paramedics and firefighters) to ensure that our research and development are applicable and useful in their organizational

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contexts. Our development of a virtual collaboration and simulation platform is firmly anchored in learning theory, with an emphasis on the importance of learning communities, relationship building, and collaboration.

This article uses the project's theoretical research as a foundation to contribute to the learning theory specific to collaboration, simulations, and experiential learning. After discussing the unique characteristics of SIMergency, I provide a critical, applied analysis of learning principles directly related to simulation and gaming; I stress the importance of balancing virtual methods with face-to-face interaction; and I examine design principles that place learning before technology in an emergency-response organizational context. As such, this article focuses on the foundational work conducted during the first year of the SIMergency 2-year project.

The SIMergency Project

Team members of the SIMergency Project are collaborating with two emergency response organizations: a firefighting department and a paramedic service. The two organizations (each in a different Canadian city) comprise shift workers and provide emergency services 24 hours a day, 7 days a week. Each organization has several hundred employees, who typically interact only with members of their own shifts. The firefighters work in crews of four to eight, whereas the paramedics work in pairs. Thus, there is little opportunity for learning or collaboration between crews or shifts.

Personnel within these organizations face unique work and learning challenges as they deal with life-and-death situations, which are stressful and unpredictable, with infinite variables. At any moment, firefighters and paramedics may be called to respond to complex emergencies dealing with factory fires, gas leaks, and car crashes. They may also respond to simpler calls dealing with small fires, heart attack victims, and accidents in the home. Regardless of the type of call, emergency response personnel must be ready for any eventuality, given that even the apparently simple calls have the possibility of becoming complex. For instance, personnel may respond to what initially seems to be a uncomplicated fire that escalates because of an explosion of flammable material. In bad weather, a two-car accident may become a multicar accident as oncoming drivers crash into a pileup in the middle of a highway. The possibilities are endless.

It is relatively straightforward to train firefighters in the scientific properties of fires and in the correct way to hold a hose and approach a fire. It is similarly straightforward to train paramedics to start an IV and to set a broken leg to transport a patient. But how can firefighters and paramedics learn to make decisions and take appropriate action in dynamic, unpredictable situations? How can they learn to deal with rapidly escalating incidents for which there may be no precedent?

To address these questions, SIMergency's focus is to create dynamic, interactive, collaborative learning opportunities for emergency response personnel that allow learners to engage in critical decision-making processes that form the core of their work. SIMergency is creating a simulation based on critical incident management at a fire scene with medical casualties. This simulation is supplemented with collaborative software to allow organizational members to discuss their work in general and their learning specific to the simulation. It is from this background that I have approached the literature relating to simulations and elearning to help inform the development of the simulation.

Simulation and gaming learning principles

SIMergency is based on the belief that the first steps in designing any technology involve ensuring that the technology supports learning based on complex collaborative learning theories, that it is designed with the learner in mind, and that it addresses the needs of the organization. To maximize the benefits of learning with technology and to take these considerations into account, I have connected learning theory with software design, beginning with the work of Gee (2003), who explores how video game designers implement learning principles to keep players using and buying their games. He presents an interesting argument as he wonders why some children and adults who spend hours learning and playing complicated video games show little interest in formal education. Gee explains 36 learning principles (pp. 207-212) inherent in good video games, of which I highlight 8 and expand on with reference to other sources. In this case, Gee's use of the word *good* means that players learn complicated rules and functions in order to play. The learning principles that are most applicable to SIMergency's elearning simulation include *active critical learning*, *psychosocial moratorium*, *committed learning* with *extended engagement*, *regime of competence*, *multiple routes*, *material intelligence*, *affinity groups*, and *multimodal* design.

If learning is to be relevant to the workplace and people's lives, if content is to be truly understood, remembered, and applied to actual practices, then learners must be engaged in *active critical learning*. In other words, it is not enough to read information and listen to a lecture. These methods can be important first steps, but learners must be actively engaged in experiential learning in order to apply their knowledge and learn their practice (Aldrich, 2004). "The most powerful knowledgeability [lies] in the doing of activities, not the application of generalized principles to practice. . . . Learning occurs as professional practitioners engage the very activity of their profession in the everyday world" (Schon, quoted in Wilson, 1993, p. 75). Learners, though respecting the experience of others, must also question what they are told. It is often the fresh perspective of a new organizational member that can lead to a critiquing of current practices and an improving of approaches. Questioning is not always welcomed, but a place should be created for this form of constructive learning in formal workplace training and everyday practice.

A *psychosocial moratorium* is key for active learning in emergency response organizations that deal with dangerous, life-and-death scenarios. Essentially, this moratorium entails allowing realistic training to occur without real consequences. The tension is maintained within the scenarios to keep learners invested in the outcome, but they are free to take risks and try new approaches that might be considered too high a risk in an actual scenario. As well, trainers have the freedom to allow learners to make mistakes and learn from them; that is, learners deal with the consequences of their actions, without trainers' needing to take over and direct the events. This finding is supported by Aldrich (2004), who discusses the importance of a safe environment, and Smith (2004), who examines crisis simulations:

> Simulations provide organizations with the opportunity to engage in trial-and-error learning and therefore to give managers the opportunity to learn within a safe environment in which they can be exposed to a range of crisis conditions and learn the limits of their own, and their organization's, capabilities. (p. 360)

Learning should be interesting and engaging to foster a learning environment where participants are eager to learn. Education need not be entertainment, but by holding learners' attention and engaging them—for instance, by using multimedia techniques and by giving immediate feedback—learners can focus their attention. Through this *engagement*, learners are likely to become *committed to ongoing learning* and hence seek out further learning opportunities. Garris, Ahlers, and Driskell (2002) refer to this as *flow*, which "represents an optimal state of performance at a task, a sense of enjoyment and control, where an individual's skills are matched to the challenges faced. Furthermore, flow derives from activities that are optimally challenging" (p. 452).

Therefore, engagement is linked to the belief that training should always be slightly more difficult than the learner's capacity, or *regime of competence*. If it is too easy, then learners feel as though they are wasting their time; if it is too difficult, learners become frustrated and do not learn productively. By keeping training levels just above their abilities, learners can become engaged and attentive, and their learning becomes maximized. "Clearly, learners are likely to sustain interest in games that are challenging and goal-oriented" (Dempsey, Haynes, & Casey, 2002, p. 166). Adjusting assistance for level of ability is similar to a technique known as *scaffolding*, where learner supports are provided only as long as the learner requires them and are gradually decreased and/or changed as the learner develops knowledge and capabilities. Scaffolding may also be necessary to help organizational members learn in nontraditional ways, such as with problem-based learning and group learning (Greening, 1998) and self-directed learning (Squire & Johnson, 2000), given that these methods may be largely foreign to them.

> In changing from a subject-based discipline to an integrated [problem-based learning] mode, it is often difficult to anticipate the need for scaffolding in non-discipline areas (such as group dynamics, metacognition, etc.). . . . It may need to be accepted that [problem-based learning] involves a slower start-up in terms of the discipline-based content that is covered. This may be due to the development of important "hidden" skills, which will ultimately facilitate deep approaches to learning. This is an important time in which to ensure that adequate scaffolding exists to support this type of development. (Greening, 1998, p. 15)

Problem-based learning skills are also important for workplaces in general, particularly those supporting collaborative learning.

Multiple routings are a vital aspect of training in challenging situations where outcomes are not predetermined. There may be procedures and rules to follow, but each decision can take participants in different directions, with no one right answer. For instance, in emergency situations, leaders may make decisions based on personal preferences, strengths of self and coworkers, and a rapidly changing environment. It is how the leader reacts to changing variables that determines the outcomes of unpredictable emergency situations. Therefore, training should not have predefined outcomes, because it would restrict learning and improvement on techniques and approaches. Developing open outcomes is supported by Greening (1998) and Squire and Johnson (2000), and it relates to the idea of emergence (Johnson, 2001): "Emergent systems can be brilliant innovators, and they tend to be more adaptable to sudden change than more rigid, hierarchical models" (p. 223). Borodzicz (2004) examines multiple routings in relation to flexibility: Using complicated events as a basis for simulations, participants must "interactively create a solution as part of the game scenario in an unstructured and flexible manner" (p. 419).

To support learning through multiple routings and flexible training, there must be a feedback loop so that participants can see the results of their actions and make informed decisions as they proceed through learning scenarios. Feedback can be in the form of experiencing the consequences of decisions made and actions taken within the training where "trial and error and the benefit of immediate feedback about the consequences of participants' decisions are key elements in the success of learning processes" (Kriz, 2003, p. 506). It is particularly critical for learners to experience the consequences of their choices when simulating events that do not follow predetermined paths and require rapid decision-making processes. Will Wright, inventor of the SIMS software, discusses the need to "deal with the chaos and the randomness. This might, ultimately, be even more realistic" (quoted in Aldrich, 2004, p. 104). This can be examined in relation to chaos theory and the requirement to find order in chaos (Leigh & Spindler, 2004):

> Chaord [Dee Hock] fuses core concepts of chaos and order to indicate the nature of modern contexts in which order is the goal but chaos is the daily experience of those involved. The skills required to be effective in such situations are not necessarily appropriate to stable linear situations, where order is valued and there is an aversion to disorder (seen as chaos). (p. 56)

Feedback is also essential in the form of debriefing (Jenvald & Morin, 2004) to reflect on actions and learning, particularly when training situations are based on seemingly chaotic events. This debriefing can be collective or individual, oral or written, and it can take place at intermediate stages or upon completion of the learning event. For instance,

> intermediate debriefing can be used to show participants the gap between actual performance and target and to give suggestions or even guidelines that may help to bridge

> this gap in subsequent rounds. This may be done by identifying mistakes or discussing alternative courses of action. (Peters & Vissers, 2004, p. 75)

Likewise, final debriefing can help participants reflect on their actions and those of others, while connecting their learning within the simulation to situations they might encounter in reality (Peters & Vissers, 2004).

The process of debriefing is essential to support learning within simulations. Petranek (2000) takes a further step when he states that "students learn much more by writing about the simulations than just by playing or orally debriefing them" (p. 108). For instance, in the SIMergency Project, learners have the opportunity to reflect on the simulation and discuss their decisions with other learners and with the organizational community in general. A debriefing discussion creates a space where members can connect their learning with actual fires and medical calls so that they can explore how they might respond to future situations and discuss how a simulation has helped to inform their understanding of past events. Learners can also describe a situation that they encountered in a simulation and ask other organizational members if they have suggestions on other actions that could have been taken that might have resulted in a different outcome.

With respect to the concept of *material intelligence*, learners in training should be able to use the resources that they would have at their fingertips in a real scenario. They should develop their own knowledge and capacities as much as possible but also be able to work with others and use all available resources. Using available resources relates to Vygotsky's zone of proximal development, also mentioned by Gee (2003) and Hung and Chen (2001). Zone of proximal development was originally developed in relation to children, but it is equally applicable to adults:

> Vygotsky defined the [zone of proximal development] as the distance between the child's "actual development level as determined by independent problem solving" and the higher level of "potential development as determined through problem solving" under adult guidance or in collaboration with more capable peers (Vygotsky, 1978, p. 86). (Hung & Chen, 2001, p. 5)

Collaboration and social interaction are made an essential part of the training and workplace practice, whereby an *affinity group* develops bonds "primarily through shared endeavors, goals and practices" (Gee, 2003, p. 212). Therefore, if emergency response learners have access to resources such as partners, crews, on-call doctors, and fire chiefs in actual settings, then these resources should be available in an elearning environment.

In a *multimodal* design, the above principles can be applied using elearning within a traditional classroom environment and in workplace practice. "The best simulation experiences are embedded within well-designed curriculums that bring together readings, discussion, and a variety of offline activities" (Bos, n.d., pp. 15-16). It is essential to have many methods from which participants can learn and communicate with one another (Robey, Khoo, & Powers, 2000), to design learning environments that recognize that participants are diverse in their learning preferences, and to provide appropriate supports (Garris et al., 2002).

To add to Gee's (2003) principles, training must be relevant and based on real-world situations (Knowles, 1980), which leads back to learning in practice. For instance, "knowledge acquired in specific situations is more powerful and useful than so-called general knowledge that it is often decontextualized and represented in abstract structures that cannot be applied in specific situations" (Orey & Nelson, 1994, p. 622). Chen and Hung (2002) use an authenticity–generalizability continuum to argue that there is a need for both practical and theoretical learning and that each reinforces the other: "Thus students are empowered to abstract situated knowledge and transfer [it] across contexts, and alternatively to contextualize abstract principles and apply them to real-life problems" (p. 151). Squire and Johnson (2000) discuss how learners must be involved with authentic participation in order to learn in the workplace and that such participation occurs only when they are engaged in actual workplace practices, as opposed to simply observing them (Savoie-Zajc & Dolbec, 2003). Collaborative learning in the workplace must be based on practice and engagement.

Balancing virtual methods with face-to-face interaction

The learning principles discussed in the above section must be implemented with both online and face-to-face interaction. Virtual learning and communication cannot stand on their own if their aim is to encourage collaboration, because it is difficult to establish trust, identity, and relationships without the element of face-to-face interaction (Barab, MaKinster, & Scheckler, 2003; Bos, n.d.; Brown & Duguid, 2000; Erault, 2002; Kimble, Li, & Barlow, 2000; Nichani & Hung, 2002; Raybourn, Kings, & Davies, 2003; Robey et al., 2000; Salmon, 2002; Schwarz, 1996). Relationship building is particularly crucial in organizations where decisions deal with life and death, whether that of a patient (as with paramedics) or that of each other (as with firefighters). Therefore, the SIMergency team is designing software that is intended to support face-to-face interaction, not replace it. This section discusses how the literature has helped to inform our decision to combine communication mediums.

Virtual contact can build community, but it is much richer when it is combined with face-to-face communication. Trentin (2001) supports this view in arguing that distance courses must incorporate "some degree of onsite activity" (p. 7) and collaborative group learning. It is possible to frame a community around virtual interaction, as long as participants are able to make adaptations to compensate for the loss of face-to-face contact, as well as participate in co-located work.

> Beyond their understanding of tools and technologies, virtual team members must develop communication practices that operate across time and space. They may develop electronically mediated substitutes for the visual and nonverbal cues that operate in teams that meet face-to-face. Virtual teams may create rules of conduct, social structures, and temporal rhythms that enable them to perform their work effectively, and they may learn to manage conflicts and disagreements in ways that make members feel psychologically safe. They may even form social and emotional bonds through their electronic interactions. (Robey et al., 2000, para. 34)

However, Robey et al. (2000) emphasize that community building can be a challenge and that "face-to-face communication may be an important ingredient in making virtual teams more effective" (para. 24). The participants in Robey et al.'s study met frequently and saw their visits as essential factors in creating and maintaining relationships to contribute to shared work, particularly when considering that casual conversations and nonverbal cues are reduced or absent when participants are not co-located. Nichani and Hung (2002) concur: "Too many nuances of a social meeting . . . cannot be replicated online. . . . Virtual connections are brief and intermittent . . . . Serendipity is limited online. . . . It is hard to build trust through purely virtual connections" (p. 53). Brown and Duguid (2000) suggest that these nuances are unconscious and virtually invisible and therefore difficult to replicate or capture virtually.

When communication is achieved through only one means (verbally or textually), it obscures much of the meaning that is received through visual and tonal means. Hutchins (1995) explains how this low-bandwidth communication impedes understanding. Using radio communications on a naval ship as an example, he argues that the short, often-prearranged signals do not allow for meaningful interaction. It "is difficult to negotiate a novel understanding of the nature of a problem or to jointly interpret a complex world on such a low-bandwidth channel" (p. 231).

One benefit of online communication involves the choice that it can allow for discussion and exchange of ideas. For instance, Salmon (2002) discusses the benefits of asynchronous online discussion versus class discussion. In an online environment, participants have more time to think about their replies, as opposed to responses made in class conversations, where the discussion is constantly changing and moving; they can go back to a point made earlier without losing the thread of context; and they do not have to take turns and compete with each other for the floor. Online responses also leave a record of discussions for later referral and reflection. However, posting responses to an online message board may be intimidating because participants know that their comments, instead of consisting of a fleeting moment in class, are captured and displayed for all to see. Online communication is most effective when combined with in-class discussions and activities, thereby giving participants a chance to engage in different manners, depending on what best suits their personalities, comfort levels, and learning styles. Also, reading online contributions or listening in class without participating is a form of legitimate peripheral participation (Bird, 2001).

Finally, virtual anonymous discussions in hierarchical organizations can allow for the challenging of ideas and practices (Kilner, 2002; Raybourn et al., 2003), which may not be the norm. The U.S. Army has created an online forum called CompanyCommand.com, which is a space for leaders to "impart tacit knowledge to [other] leaders through vicarious experiences, and they do not merely share and transfer knowledge; they actually help to create a new knowledge" (Kilner, 2002, p. 22). The U.S. Army is an extremely hierarchical, traditional organization, and its use of collaborative tools is a telling acknowledgment of the need to change practices to support continual learning and make room for emergent practices. Knowledge comes from leaders and organizational members, and it is vital to foster the sharing of this knowledge.

The firefighters and paramedics involved with the SIMergency Project have little opportunity for face-to-face interaction within their work settings. Organizational members work in shifts from various locations and may occasionally see other members at formal training sessions and in their day-to-day work—for instance, paramedics may see each other briefly when they transfer patients to hospitals—but seldom if ever collaborate with co-workers outside their crew or shift. Therefore, using virtual communication is key so that members can learn from those with whom they would not otherwise have contact. This is balanced with face-to-face contact during formal training sessions.

Design considerations to put learning before technology

The issue of balancing virtual and face-to-face learning naturally leads to technology design considerations. Technology can be seen as an integral part of learning complexities; in fact, it is argued that technology has changed the nature of our working lives, although not always for the better. Vincente (2003) discusses the fact that technology is often created and applied merely because it exists, without consideration of how its implementation will affect its users: "Design should begin by identifying a human or societal need—a problem worth solving—and then fulfill that need by tailoring the technology to the specific, relevant human factors" (p. 45). An important aspect of this concerns the fit between humans and technology.

Vincente (2003) also discusses the division between the viewpoints of those who work with the human sciences and have a humanistic view and the viewpoints of those who work with the technical sciences and have a mechanistic view: "Unfortunately, this traditional approach has created two breeds of Cyclops—the one-eyed Humanist who can focus on people but not technology, and the one-eyed Mechanistic variety who knows about technology but not people. We're all walking around half-blind" (p. 32). His most important point follows from this: "*Our traditional ways of thinking have ignored—and virtually made invisible—the relationship between people and technology*" (p. 33, italics in original). Therefore, technology does not always result in more effective and efficient ways of doing things, and people are often blamed for not using technology properly, when perhaps it is the design of technology that is at fault.

Throughout his book, Vincente (2003) links this argument to the literature relating to human factors engineering and ergonomics. For instance, he discusses a situation in the early 1940s when the U.S. military had frequent occurrences of pilots' intending to retract flaps after landing but retracting landing gear instead. This was initially considered pilot error because there was nothing wrong with the equipment, but this response did not address the fact that it was a common occurrence. In examining these incidents, Lieutenant Chapanis took a different approach and reframed the problem, realizing that the switches that controlled these functions "had no affinity with human manual dexterity" (p. 75). The switches were too close and too similar in appearance to prevent their being mistaken for each other. By changing their shapes—using a wedge for the flaps switch and a disc for the landing gear—he eliminated the error. The problem was not human error but a "*bad fit* between people and technology" (p. 44, italics in original), a recurring theme in Vincente's work.

Therefore, it is essential to ensure that technology fits our learning goals, not vice versa. Postman (1992) and Schwarz (1996, building on Postman's work) address these concerns by warning how technology can drive learning. Postman terms our present North American society a *Technopoly*, wherein increasing access to technology and information has degraded our confidence in our own knowledge; that is, science has become the answer for questions we have not yet formed: "for example, the explanations of 'The computer shows . . . ' or 'The computer has determined . . . ' It is Technopoly's equivalent of the sentence 'It is God's will,' and the effect is roughly the same" (p. 115). Schwarz emphasizes that we must not uncritically accept technology as a given but question our use of it: Why are we using technology? How can certain types of technology support our work? Is technology supporting or hindering learning? In fact, technology can be too advanced and so move beyond our capability to process and apply information (Stanton, Chambers, & Piggott, 2001). Finally, we must realize that technology is not always a part of the answer (Helmreich, 2000, in Sexton, Thomas, & Helmreich, 2001). In our case, how can technology support and enhance collaborative learning among emergency response personnel?

To begin, we must support collaboration and informal learning opportunities (Dixon, 1999; Raybourn et al., 2003) as well as reflection (Salmon, 2002) and situational awareness (Stanton et al., 2001). The software should be easy to access (Renwick, 2001) and intuitive to use (Gee, 2003). Naturally, the goal is not to create an electronic barrier to learning but to make it more accessible.

The actual design of the software should be created by those who will use it; it cannot be designed outside an organization and then dropped in with the expectation that it will meet the users' needs (Barab et al., 2003). Furthermore, community members are much more likely to support and use a virtual learning site when they have been consulted about the design and have created a shared feeling of ownership toward it (Salmon, 2002). The members are the ones who have the best resources to determine what they require (Brown & Duguid, 2000), and the process of contributing to the learning site can begin or continue to create community (Raybourn et al., 2003). For the SIMergency Project, organizational (community) members have been engaged from the beginning through consultations, interviews, focus groups, and on-site observations to ensure that their learning needs are met and supported. In addition, the data that are used for the learning scenarios are being adapted from real events that participants believe accurately represent the challenges they face. In this way, the learning pedagogy, content, and methods become directly relevant to each organization.

The design of the technology must support experiential collaborative learning, but the design itself will not necessarily lead directly to this end (Trelaven & Cecez-Kecmanovic, 2001). McDermott (2000) emphasizes the importance of designing the "social side of collaborative technology" (p. 5), and Deloitte Research (2001) focuses on "allowing people to build social networks connected by technology" (p. 6). These authors reinforce the position that technology is simply a tool that is used as needed to support goals that lie outside a technocratic viewpoint. The phrase *computer-assisted*, as used in “Feeling the Heat” (1997), “means just that. . . . It is not completely under the computer’s control” (para. 3). The article discusses software used for the training of offshore oil-rig operators, and it recognizes that people drive the technology, which should only be used as a tool. Participants are in control of the process and, therefore, the outcome, where micropractices and everyday activities are understood and incorporated (Clases & Wehner, 2002).

Conclusion

At the beginning of this article, I ask the following questions: How can firefighters and paramedics learn to make decisions and act in dynamic, unpredictable situations? How can they learn to deal with rapidly escalating incidents for which there may be no precedent? To answer, I drew on theory relating to simulations and elearning, and I applied it to the dynamic, unpredictable, often-dangerous field of emergency response. The learning principles that SIMergency is using as the basis for its project stem from complex learning theories entwined with collaborative communities. Partially adapted from Gee (2003), these learning principles can be described as active critical learning; engagement and commitment to continued learning; increasing levels of difficulty with decreasing levels of support; access to peers, experts, and material resources; multimodal design; multiple routings, feedback, working through errors and debriefing to allow for emergence, innovation, and application; and relevant training based on real-world situations but with mitigated consequences and risks.

By combining these concepts to support learning processes through virtual collaboration and formal simulation training, our emergency-response-partner pilot sites will benefit from the support of collaborative communities, organizational experience, and sound learning principles. These will engage them as learning organizations and so support continuous, collaborative, innovative learning.

References

Aldrich, C. (2004). *Simulations and the future of learning: An innovative (and perhaps revolutionary) approach to e-learning*. San Francisco: John Wiley.

Barab, S. A., MaKinster, J. G., & Scheckler, R. (2003). Designing system dualities: Characterizing a Web-supported professional development community. *Information Society, 19*(3), 237-256.

Bird, L. (2001, December). *Virtual learning in the workplace: The power of “communities of practice.”* Paper presented at “Meeting at the Crossroads: Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education,” Melbourne, Australia.

Borodzicz, E. (2004). The missing ingredient is the value of flexibility. *Simulation & Gaming, 35*(3), 414-426.

Bos, N. (n.d.). *What do game designers know about scaffolding? Borrowing SimCity design principles for education*. Menlo Park, CA: Center for Innovative Learning Technologies. Retrieved July 16, 2007, from http://www-personal.si.umich.edu/~serp/work/SimCity.pdf

Brown, J., & Duguid, P. (2000). *The social life of information*. Boston: Harvard Business School Press.

Chen, D., & Hung, D. (2002). Two kinds of scaffolding: The dialectical process within the authenticity–generalizability (A-G) continuum. *Educational Technology & Society, 5*(4), 148-153.

Clases, C., & Wehner, T. (2002). Steps across the border—Cooperation, knowledge production and systems design. *Computer Supported Cooperative Work: The Journal of Collaborative Computing, 11*(1/2), 39-54.

Deloitte Research. (2001). *Collaborative knowledge networks: Driving workplace performance through web-enabled communities.* Retrieved July 16, 2007, from http://www.deloitte.com/dtt/cda/doc/content/DTT_DR_CKNWorkforce.pdf

Dempsey, J. V., Haynes, L. L., & Casey, M. S. (2002). Forty simple computer games and what they could mean to educators. *Simulation & Gaming, 33*(2), 157-168.

Dixon, N. (1999). The hallways of learning. In *The organizational learning cycle: How can we learn collectively* (2nd ed., pp. 43-61). Brookfield, VT: Gower.

Erault, M. (2002, April). *Conceptual analysis and research questions: Do the concepts of "learning community" and "community of practice" provide added value?* Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.

Feeling the heat. (1997). *Economist, 344*, 79.

Garris, R., Ahlers, R., & Driskell, J. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-467.

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Greening, T. (1998). Scaffolding for success in problem-based learning. *Medical Education Online, 3*, 1-20.

Hung, D., & Chen, D. (2001). Situated cognition, Vygotskian thought and learning from the communities of practice perspective: Implications for the design of Web-based e-learning. *Education Media International, 38*(1), 3-12.

Hutchins, E. (1995). *Cognition in the wild*. Cambridge, MA: MIT Press.

Jenvald, J., & Morin, M. (2004). Simulation-supported live training for emergency response in hazardous environments. *Simulation & Gaming, 35*(3), 363-377.

Johnson, S. (2001). *Emergence: The connected lives of ants, brains, cities and software*. New York: Simon & Schuster.

Kilner, P. (2002, May–June). Transforming army learning through communities of practice. *Military review, 82,* 21-27.

Kimble, C., Li, F., & Barlow, A. (2000). Effective virtual teams through communities of practice. *Management Science: Theory, Method, and Practice*, 1-15.

Knowles, M. (1980). What is andragogy? In *The modern practice of adult education: From pedagogy to andragogy* (2nd ed., pp. 40-62). New York: Cambridge Books.

Kriz, W. (2003). Creating effective learning environments and learning organizations through gaming simulation design. *Simulation & Gaming, 34*(4), 495-511.

Leigh, E., & Spindler, L. (2004). Simulations and games as chaordic learning contexts. *Simulation & Gaming, 35*(1), 53-69.

McDermott, R. (2000). Critical success factors in building communities of practice. *Knowledge Management Review, 3*(2), 5.

Nichani, M., & Hung, D. (2002). Can a community of practice exist online? *Educational Technology, 42*(4), 49-54.

Orey, M. A., & Nelson, W. A. (1994, February). *Situated learning and the limits of applying the results of these data to the theories of cognitive apprenticeships.* Paper presented at the national convention of the Association for Educational Communication and Technology, Nashville, TN.

Peters, V., & Vissers, G. (2004). A simple classification model for debriefing simulation games. *Simulation & Gaming, 35*(1), 70-84.

Petranek, C. (2000). Written debriefing: The next vital step in learning with simulations. *Simulation & Gaming, 31*(1), 108-118.

Postman, N. (1992). *Technopoly: The surrender of culture to technology.* New York: Knopf.

Raybourn, E. M., Kings, N., & Davies, J. (2003). Adding cultural signposts in adaptive community-based virtual environments. *Interacting with Computers, 15*, 91-107.

Renwick, K. (2001, March). *Learning to learn online: Box Hill Learning Network.* Paper presented at the Australian Vocational Education and Training Research Association conference "Research to Reality: Putting VET Research to Work," Adelaide, Australia.

Robey, D., Khoo, H. M., & Powers, C. (2000). Situated learning in cross-functional teams. *Technical Communication, 47*(1), 51-66.

Salmon, G. (2002). Mirror, mirror, on my screen . . . : Exploring online reflections. *British Journal of Educational Technology, 33*(4), 379-391.

Savoie-Zajc, L., & Dolbec, A. (2003). Co-operative education in the pulp and paper sector in Quebec. *Journal of Workplace Learning, 15*(3), 114-122.

Schwarz, G. (1996). The rhetoric of cyberspace and the real curriculum. *Journal of Curriculum and Supervision, 12*(1), 76-84.

Sexton, J. B., Thomas, E. J., & Helmreich, R. L. (2001). Error, stress, and teamwork in medicine and aviation: Cross sectional surveys. *Journal of Human Performance in Extreme Environments, 6*(1), 6-11.

Smith, D. (2004). For whom the bell tolls: Imagining accidents and the development of crisis simulation in organizations. *Simulation & Gaming, 35*(3), 347-362.

Squire, K. D., & Johnson, C. B. (2000). Supporting distributed communities of practice with interactive television. *Educational Technology Research and Development, 48*(1), 23-43.

Stanton, N. A., Chambers, P. R. G., & Piggott, J. (2001). Situational awareness and safety. *Safety Science, 39*, 189-204.

Trelaven, L., & Cecez-Kecmanovic, D. (2001). Collaborative learning in a Web-mediated environment: A study of communicative practices. *Studies in Continuing Education, 23*(2), 169-183.

Trentin, G. (2001). From formal training to communities of practice via networked-based learning. *Educational Technology, 41*(2), 5-14.

Vincente, K. (2003). *The human factor: Revolutionizing the way people live with technology.* New York: Knopf.

Wilson, A. L. (1993). The promise of situated cognition. *New Directions for Adult and Continuing Education, 57*, 71-79.

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